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(71) Applicant: WESTPORT TRADING COMPANY, INC. [US/US]; 821-A 13th Street, Modesto, CA 95354 (US).

(72) Inventor: BRIGHT, LYN, E.; 3625 Lockwood Road, Ceres, CA 95307 (US).

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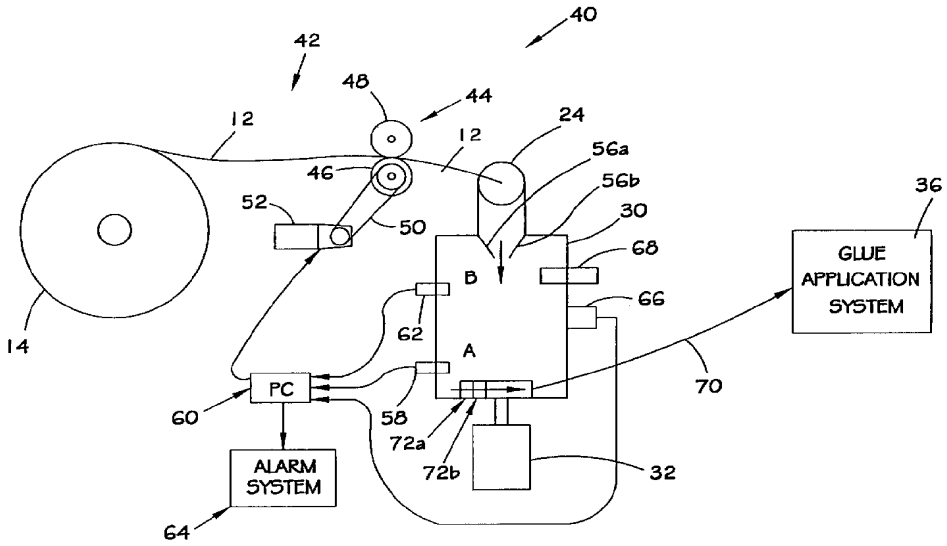
(54) Title: METHOD AND APPARATUS FOR CONTINUOUS APPLICATION OF HOT-MELT ADHESIVE



(57) Abstract: A hot-melt adhesive arrangement (10) and glue application system (36) are provided for continually supplying adhesive in solid-form to a glue pot (30). The solid-form adhesive is processed to form a continuous strand (12) or flat sheet (18), and wrapped around a feed spool (14). The solid-form adhesive is then unwound for feeding directly into the glue pot (30), or optionally fed into a preheating chamber (26) to partially or completely melt the adhesive before being fed into the melting pot. The present invention allows for continuous replenishment of a glue pot (30) while improving the quality and consistency of the melted-form adhesive pumped from the glue pot (30) for use in labeling, packaging, or other commercial and industrial processes.

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PATENT APPLICATION

METHOD AND APPARATUS FOR CONTINUOUS APPLICATION OF HOT-MELT ADHESIVE

BACKGROUND OF THE INVENTION

TECHNICAL FIELD

This invention pertains generally to feed systems for hot-melt adhesive materials and, more particularly, to a method and apparatus for automatically and continuously applying hot-melt adhesive within predetermined temperature and viscosity ranges.

BACKGROUND ART

One of the most versatile and widely used methods of joining objects together is through the use of adhesive materials. Adhesive materials are currently available in many forms, one of which is referred to as "hot-melt" adhesive. Hot-melt adhesive is particularly popular in commercial and industrial applications due to the ease of handling in the cooled state and controllable flow characteristics in the heated or melted state. Other desirable characteristics of hot-melt adhesive are its quick-setting, adhesive "tack" and gap-filling properties.

Despite the foregoing desirable characteristics of hot-melt adhesive, the adhesive must undergo a change in state before it can be used; namely, the adhesive must be heated so that it changes from a solid state to a fluid state before the adhesive can be applied to an object. However, this seemingly simple process poses a considerable challenge to the use of automated equipment for applying hot-melt adhesive in commercial and industrial applications. To appreciate this problem more fully, an understanding of basic hot-melt adhesive application systems will be helpful.

For example, a basic system commonly used for applying hot-melt adhesive includes a melting pot, a pump, a hose, and an application nozzle. The pot, which is normally rectangular in shape but can have other shapes such as square or round, is heated by means of a heating element typically located at the bottom of the pot, although the heating element can be positioned at any point in the pot elevation or structure. The adhesive is melted in the pot and then pumped through the hose to the application nozzle. Depending upon the

characteristics of the objects to which the adhesive is being applied, the type of nozzle may vary but typically comprises a spray nozzle or a glue bar which then spreads the adhesive over the surface of an object. In certain applications, such as in the labeling industry, the melted adhesive will be spread over a glue wheel which in turn transfers the adhesive to label stock much like ink is spread in a gravure printing press. If the maximum temperature of the glue is exceeded at any time during the heating process a distinct color change occurs within the glue and with continued heating it can become charred. A glue pan is often used to catch excess adhesive which is then returned to the pot directly or through a filtration system for recirculation.

With this in mind, it will be appreciated that a number of problems can arise when adhesive must be applied on a continuous and consistent basis. One difficulty is continuously feeding the glue pot while at the same time keeping the adhesive within a prescribed temperature and viscosity range that allows for viscosity and open/set time necessary for the application. Other difficulties involve temperature differentials at the point of application of the adhesive which create "stringing" of the adhesive, distortion of materials, and/or contamination of the object or components in the system. Each of these situations can result in lower production efficiencies and poor adhesion characteristics.

Many of the problems associated with applying hot-melt adhesives have been solved by various means, but a remaining problem stems from the need to continually add unmelted adhesive to the glue pot so that the flow of adhesive is not interrupted. Once the pot is brought up to temperature and the adhesive is in a melted state, additional adhesive is added to the top of the glue pot as the already melted adhesive is being pumped out of the bottom of pot. To do so, the lid on the pot is opened and the new adhesive, which is in its solid state, is dropped into the already melted adhesive for subsequent melting. However, because of the temperature differentials between adhesive in its solid state and adhesive in its liquid state, adding the unmelted adhesive lowers the temperature of the melted adhesive and produces an undesirable temperature shock to the system. In addition, because the lid on the glue pot must be opened to add the adhesive, every time the lid is opened there is a containment heat loss problem and oxygen is introduced into the system. The result is an overall temperature reduction and oxygenation which adversely affects the flow and application of adhesive.

In general, attempts have been made to solve this temperature loss problem through the use of what is referred to in the industry as "pillows" or small dime size "droplets" of adhesive. By adding the adhesive to the glue pot in small pieces at the proper feed rate, it is possible to achieve surface to temperature ratios that create an optimal condition for the preparation of the adhesive for application and to maintain the desired temperature and viscosity parameters. However, this approach requires attended operation of the system, thereby introducing operator error into the process. For example, if the operator adds too much solid adhesive to the glue pot, the overall temperature will be still be reduced and a chain of events will be created that ultimately leads to the above-mentioned production problems.

One known attempt to solve the problem of maintaining proper adhesive temperature as the glue pot is replenished has been the use of a pre-melt unit to provide additional and separate capacity to melt the adhesive, thus providing for softened or melted adhesive to be added to the glue pot as required. However, similar operational issues, such as the potential for operator error, as those described above, have proven this method to be ineffective and cumbersome as a long term solution.

Therefore, a need exists for a method and apparatus that will provide for the continuous replenishment of the glue pot with adhesive while maintaining the desired range of temperature and viscosity. The present invention satisfies that need, as well as others, and overcomes deficiencies found in conventional approaches to the use of hot-melt adhesive materials.

DISCLOSURE OF INVENTION

As stated above, the present invention pertains to a method and apparatus for automatically and continuously applying hot-melt adhesive within predetermined temperature and viscosity ranges.

By way of example, and not of limitation, the present invention solves the problems inherent in conventional hot-melt adhesive application systems by employing a supply of hot-melt adhesive which is fed into the glue pot on demand. In the preferred embodiment, hot-melt adhesive in its solid state is wrapped around a spool for support, and the spool is mounted to, or forms a part of, an adhesive loading mechanism located in the system. The solid hot-melt adhesive is preferably extruded in a continuous strand similar to rope or in a flat-form similar to a sheet, either of which is wrapped around the spool like a ribbon. While a roll-fed form of adhesive is preferred, it will be appreciated that the adhesive and its associated support

mechanism, as well as other specific aspects of the invention described below, can be embodied in other forms without departing from the present invention. The loading mechanism is coupled to the glue pot and configured to unwind the spool and feed the adhesive into the glue pot on demand, so that there is a continuous supply of melted adhesive for subsequent output. The loading mechanism can be operated continuously at a predetermined speed, triggered automatically when the amount of adhesive in the glue pot falls to a predetermined level or another predetermined criteria is reached, or operated manually if desired.

In accordance with additional aspects of the present invention, a pre-heat device such as a chamber, pot, or the like can be positioned between the adhesive loading mechanism and the input to the glue pot to soften or partially melt the adhesive unwound from the spool before it enters the glue pot, or even completely melt the adhesive so that it enters the glue pot already in a melted form. To facilitate feeding the glue pot with already melted adhesive, the temperature of the pre-heat device would be higher than typically employed in the pot to account for heat loss during the transfer of melted adhesive from the pre-heat device to the glue pot.

It will be appreciated that the size of the spool of adhesive roll is limited only to the practical considerations of the application. For example, a pallet with one large spool could be provided to supply a feed of glue for days, if not weeks or months. Alternatively, a lightweight spool could be formed so that the spool could be put into place and fed by a wide range of operators. Also, a plurality of spools of adhesive can be provided, and arranged to provide multiple simultaneous feeds, or spliced together to form a single continuous feed. It will further be appreciated that a combination of feed mechanisms could be employed where, for example, some adhesive is fed directly into the glue pot while an additional amount of adhesive is heated in the pre-heat chamber prior to being fed into the glue pot.

As can be seen, therefore, in accordance with the present invention the design of the glue pot and the physical structure of the adhesive are altered in relation to conventional approaches to allow for a continuous feed of the adhesive while also eliminating any need to open the pot during resupply of the adhesive. Because of the ability to continuously feed the adhesive, the present invention advantageously lowers the amount of adhesive which must be maintained in the pot available for application on demand. Accordingly, the size of the glue pot may then be reduced.

An object of the invention is to provide an adhesive arrangement and glue application

system which overcomes the above-noted problems of conventional systems in a cost effective manner.

Another object of the invention is to provide an adhesive arrangement and glue application system which allow for continuous feeding of adhesive while also improving the quality and consistency of the adhesive for use in any commercial or industrial application, including labeling, packaging applications, and parts assembly.

Another object of the invention is to provide an improved adhesive arrangement and glue application system which can continuously feed adhesive in a solid or partial solid state into a glue pot.

Another object of the invention is to provide an improved adhesive arrangement and glue application system which can continuously feed adhesive in a melted state into a glue pot.

Further objects and advantages of the invention will be brought out in the following portions of the specification, wherein the detailed description is for the purpose of fully disclosing preferred embodiments of the invention without placing limitations thereon.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be more fully understood by reference to the following drawings which are for illustrative purposes only, and where like reference numbers denote like parts:

FIG. 1 is a perspective view of a spool of adhesive in accordance with a first (stranded) embodiment of the present invention.

FIG. 2 is a perspective view of a spool of adhesive in accordance with a second (ribbon) embodiment of the present invention.

FIG. 3 is a schematic diagram in perspective of an embodiment of a glue-pot with a pre-heat device which is being fed solid adhesive continuously according to the present invention.

FIG. 4 is a schematic diagram of an embodiment of a continuous glue application system according to the present invention employing the glue pot and feed arrangement shown in FIG. 1 but with the pre-heat device removed.

FIG. 5 is a partial schematic diagram of an embodiment for the feed roller portion of the adhesive loader portion of the invention shown in FIG. 4.

FIG. 6 is a schematic diagram of an alternate embodiment of the adhesive feed mechanism shown in FIG. 4 configured with a second adhesive loader to maintain an adhesive feed loop with slack.

FIG. 7 is a schematic diagram of an alternative embodiment of the adhesive feed mechanism shown in FIG. 4 wherein adhesive pillows are dispensed from a hopper onto a conveyor.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring more specifically to the drawings for illustrative purposes, the present invention is embodied in the apparatus generally shown in FIG. 1 through FIG. 7, where like reference numbers denote like parts, and in the process steps described in connection therewith. It will be appreciated that the apparatus may vary as to configuration and as to details of the parts, and that the method may vary as to the specific steps and sequence, without departing from the basic concepts as disclosed herein.

Referring first to FIG. 1, an adhesive arrangement 10 in accordance with a first embodiment of the present invention is shown. More specifically, as shown, hot-melt adhesive is processed or extruded into a continuous strand 12 and wrapped around a spool 14 for support and subsequent dispensing, about axis 16. While the adhesive can have round, triangular, hexagonal or other regular or irregular cross-sectional shapes, flat ribbons or sheets of adhesive are preferred. FIG. 2 shows a second embodiment of this arrangement wherein the hot-melt adhesive is processed or formed into a continuous flat ribbon or sheet 18. For many applications, a thinner and wider adhesive strip is preferred because such an arrangement facilitates rapid melting. The hot-melt adhesive itself can be made from any suitable process and formulation known in the art. Therefore, the specific composition of hot-melt adhesive used in the present invention is not critical and will not be described herein.

Further, the rolls can be formed in a size that best suits the intended application. For example, in a high speed labeling machine, a ten to twenty pound roll can supply a half-shift of production, thereby reducing the need for an operator to constantly monitor glue levels. In addition, the adhesive can be coated with a powder such as cornstarch before being rolled onto the spool so as to facilitate easier dispensing by reducing the tackiness of the adhesive, increasing pliability of the roll as it is unwound, and reducing the amount of adhesive potentially lost during use. Also, commercially available adhesives having a sheath around the adhesive can be used to prevent undesired blocking (sticking) of the material. Such sheaths are designed become part of the melted adhesive, so contamination is not a problem. Various manufacturers, such as Croda and National Adhesives supply adhesives having the above-

described sheath.

Referring now to FIG. 3 and FIG. 4, a system for continuous application of hot melt adhesive according to the present invention is shown. In FIG. 3, a basic glue pot and feed mechanism 20 are shown as an introduction to the more detailed embodiment of FIG. 4. FIG. 3 shows the adhesive strand material 12 being fed from spool 14 into the input 22 of a feed tube 24. The solid adhesive material moving through feed tube 24 is first heated by a pre-heat device 26 before it exits the output 28 of feed tube 26 into the glue pot 30. A pump 32 then pumps the melted adhesive 34 from glue pot 30 to a glue application system 36 (FIG. 4) which performs adhesive application. Note that pre-heat device 26 optimizes the processing of the hot-melt adhesive. This pre-heat device can include a heating element 38 located in proximity to the solid hot-melt adhesive, which is arranged to maintain a higher temperature within the pre-melt device than the temperature within the glue pot, or any other suitable heating element. Note also that pre-heat device 26 can be a chamber, another glue pot, or other heating system that is intermediate to hot-melt adhesive 12 and glue pot 30.

Referring more particularly to FIG. 4, a preferred embodiment of a complete continuous feed glue application system 40 is shown. Note that pre-heat device 38 is not shown in FIG. 4, but would be incorporated as described above with reference to FIG. 3. As can be seen, the system comprises three basic stages. The first stage comprises an adhesive feed system 42 comprising spool 14 with adhesive 12 and an adhesive loader 44. The second stage comprises glue pot 30 where the adhesive is melted, and the third stage comprises glue application system 36 where the hot liquid glue is distributed and applied.

In accordance with an embodiment of adhesive feed system 42, spool 14 with adhesive 12 is rotatably mounted about axis 16 to any conventional spool support. Adhesive loader 44 is provided to controllably unwind the adhesive from the spool, and feed the unwound adhesive into the glue pot. Preferably, adhesive loader 44 includes a motor driven bottom roller 46 which operates in conjunction with a powered or un-powered upper roller 48 to create a pulling force on the adhesive when the adhesive is positioned between the two rollers. The pulling force unwinds the solid-form adhesive from the spool at a controlled rate for feeding into the adhesive application system. Bottom roller 46 can be driven using a pulley/belt arrangement 50 coupled to a motor 52. Alternatively, both rollers could be powered or the top roller could be powered with the bottom roller being un-powered. Referring also to FIG. 5, the outer surfaces of the two rollers can be configured to increase friction or gripping ability between

bottom roller 46 and top roller 48 by adding a plurality of teeth 54 around the periphery of the rollers, a portion of which are shown in FIG. 5, or other suitable surface appendages, or by providing rollers with appropriate surface roughening. Additionally, non-stick coatings can be added to the surface such rollers so that the solid-form glue does not adhere to the roller. Motor 52 may be any suitable type of motor, including a DC stepper or servo type motor. In addition, a direct drive arrangement could be substituted for the belt drive arrangement shown.

Referring again to FIG. 4, feed system 42 directs the end of the solid adhesive 12 is into feed tube 24. Preferably feed tube 24 is located in the top of glue pot 30 so as to allow gravity to assist feeding of the adhesive into the pot. A safety flap arrangement is also provided within the glue pot to seal off feed tube 30 and prevent any backflow or overflow of melted adhesive if the level of adhesive in the pot ever reached the top. In the embodiment shown, the flap arrangement is formed by a pair of swinging doors 56a, 56b mounted via suitable hinges (not shown) to an inside surface of the top of the pot. Each door preferably would be mounted at an angle relative to the level of the glue such that when the glue level is below the doors, gravity will allow the doors to hang down into the pot, but as the glue level rises, the glue will make contact with the doors and force them upward into a closed position.

In the preferred embodiment of the invention, control of the feed motor 52 is automated through a feedback sensor arrangement associated with the glue pot. As shown, a low level sensor 58 provides an output signal indicative of the glue level in the pot reaching a low point AA@. Output of a low level signal causes a controller 60 to activate the feed motor to add more adhesive to the pot. A high level sensor 62 provides an output indicative of the level of glue in the pot reaching a desired high point AB@. Controller 60 stops motor 52 in response to a high signal. Sensors 58 and 62 can be implemented using any suitable type of level sensor, such as an infrared (IR) transmitter/receiver arrangement which can pass a beam of light across the inside of the glue pot.

Controller 60 is preferably implemented as a programmed data processing system, such as a personal computer, programmed to monitor the sensors to control operation of motor 52. In addition, controller 60 controller can be connected to an audible and/or visual alarm system 64 to provide an alert to system operators regarding glue level in the pot or malfunction of motor 52. In addition, a color monitoring sensor 66 can be connected to the glue pot for providing an output signal indicative of the color of the glue. Such a sensor arrangement can

provide, for example, an indication of glue burning. This color detecting sensor can be output directly to an alarm or processed by controller 60 which provides output to the alarm system and/or to the heat control arrangement. Glue pot 30 can be heated to a desired temperature using any suitable type of heating arrangement (not shown), such as a conventional burner unit, a microwave unit, or heating elements mounted around glue pot 30 at any suitable position along the elevation of the pot. If desired, a temperature sensor 68 can be mounted to the glue pot to provide a feedback control signal for controlling operation of the heating elements to maintain the desired temperature level. A conventional thermostatic control system with an adjustable set point or the like can be employed for this purpose. Other parameters, such as viscosity of the melted adhesive, could be monitored and controlled as well.

In this manner, therefore, solid hot-melt adhesive can be continuously supplied from spool 12 to allow glue to be continually fed into the glue pot without any operator intervention. The melted adhesive can then be pumped through a glue line 70 by pump 32 to glue application system 36. In one embodiment, pump 32 comprises an air pump that pumps glue from an outlet in the bottom of the glue pot and into glue line 70. Alternatively, the melted adhesive could be gravity feed to glue application system 36 to reduce complexity. The melted glue preferably is filtered by at least one strainer which is connected to the pot at the outlet before distribution through glue line 70. A preferred embodiment utilizes two strainers, 72a, 72b, connected back to back. The glue application system 36 can also include heated control nozzles (not shown) to further improve application results.

Referring now to FIG. 6, in order to facilitate a smooth and continuous feed for adhesive 12 from spool 14, a second adhesive loader 74 having a top roller 76 and a bottom roller 78 could be employed as schematically shown. Either one or both of the rollers could be powered and configured in the same way as previously described with respect to rollers 46, 48 in adhesive loader 44. The purpose of this arrangement would be to provide a loop 80 in the continuous strand of adhesive to maintain slack. In this way, potential intermittent changes in feed speed can be eliminated that could otherwise result from binding or the like in spool 14. Adhesive loader 44 would continue to operate as a "finite feeder" in the same manner as heretofore described, and adhesive loader 74 would function as a "rough feeder" to maintain slack in loop 80. Loop 80 could be guided by an arcuate channel, roller or the like (not shown) within a housing 82 having optical sensors 84a, 84b operatively coupled to controller 60 to monitor the configuration of loop 80 and control the operation of adhesive loader 74 to

maintain slack in the loop.

While the adhesive feed system has been described in terms of a single spool, another option for feeding the solid adhesive material is to provide a feed rack formed from a plurality of spools (not shown). Each of the spools can be connected to the loader so as to provide an input feed to the adhesive loader. The multiple spools can be arranged to provide multiple simultaneous feeds, or spliced together to form a single continuous feed.

Another adhesive feed option contemplated would be to feed pre-cut flat strips of adhesive, blocks of adhesive, or "pillows" of adhesive into the glue pot from a cartridge, magazine or hopper. Alternatively, the pieces of adhesive could be fed onto a conveyor which, in turn, feeds the glue pot. FIG. 7 schematically shows a hopper 86 from which conventional adhesive pillows 88 having a surrounding sheath are dropped onto a conveyor 90 for delivery to the glue pot.

Yet another option is to provide an air-conditioner (AC) unit (not shown) in conjunction with the roll(s) of adhesive to keep the rolls in a cooled state. This improves handling of the adhesive by the dispensing arrangement, as well as reduces the amount of adhesive lost when the rolls are heated and melted.

Also, while feeding the glue into a glue pot has thus far been described, the adhesive could alternatively be fed directly into the glue application system 26, such as a glue bar, spray head, or other application head, that contains a heating element.

Accordingly, the present invention enhances a hot-melt adhesive application system by continually supplying adhesive in solid-form to a glue pot. The adhesive can be fed directly into the glue pot or, optionally, fed into a pre-heating chamber to partially or completely melt the adhesive before being fed into the melting pot. The present invention allows for continuous replenishment of a glue pot while improving the quality and consistency of the melted-form adhesive pumped from the glue pot for use in labeling, packaging, or other commercial and industrial processes.

Although the description above contains many specificities, these should not be construed as limiting the scope of the invention but as merely providing illustrations of some of the presently preferred embodiments of this invention. Thus the scope of this invention should be determined by the appended claims and their legal equivalents. Therefore, it will be appreciated that the scope of the present invention fully encompasses other embodiments which may become obvious to those skilled in the art, and that the scope of the present

invention is accordingly to be limited by nothing other than the appended claims, in which reference to an element in the singular is not intended to mean "one and only one" unless explicitly so stated, but rather "one or more." All structural, chemical, and functional equivalents to the elements of the above-described preferred embodiment that are known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the present claims. Moreover, it is not necessary for a device or method to address each and every problem sought to be solved by the present invention, for it to be encompassed by the present claims. Furthermore, no element, component, or method step in the present disclosure is intended to be dedicated to the public regardless of whether the element, component, or method step is explicitly recited in the claims. No claim element herein is to be construed under the provisions of 35 U.S.C. 112, sixth paragraph, unless the element is expressly recited using the phrase "means for."

CLAIMS

What is claimed is:

1. A hot-melt adhesive application apparatus, comprising:

(a) a glue pot configured for holding melted hot-melt adhesive for use with an adhesive application device;

(b) a supply of hot-melt adhesive in a solid-form wrapped around a spool; and

(c) an adhesive loader configured to unwind said solid-form hot-melt adhesive from said spool for input into said glue pot.

2. An apparatus as recited in claim 1, further comprising a pump fluidly connected to said glue pot and configured for pumping melted hot-melt adhesive from said glue pot to said adhesive application device.

3. An apparatus as recited in claim 1, wherein said melted-hot melt adhesive is gravity fed from said glue pot to said adhesive application device.

4. An apparatus as recited in claim 1, further comprising a pre-heat device positioned between said adhesive loader and said glue pot for pre-heating said hot-melt adhesive unwound from said spool before said hot-melt adhesive is input into said glue pot.

5. An apparatus as recited in claim 1, wherein said solid-form hot-melt adhesive comprises a continuous strand.

6. An apparatus as recited in claim 1, wherein said solid-form hot-melt adhesive comprises a continuous flat sheet.

7. An apparatus as recited in claim 1, wherein said solid-form hot-melt adhesive has a cross-sectional shape selected from the group of shapes consisting of circular, square, rectangular, hexagonal, and irregular.

8. An apparatus as recited in claim 1, wherein said adhesive loader comprises:

(a) a pair of feed rollers positioned to cooperatively pull said supply of hot-melt adhesive between said feed rollers; and

(b) a motor coupled to at least one of said feed rollers to draw said supply of hot-melt adhesive from said spool.

9. An apparatus as recited in claim 8, wherein said feed rollers include a frictional surface for contacting said supply of hot-melt adhesive.

10. An apparatus as recited in claim 1, wherein said pre-heat device maintains said adhesive at a higher temperature than the temperature within said glue pot.

11. An apparatus as recited in claim 1, further comprising:

(a) a level sensor coupled to said glue pot for detecting a low level and a high level of melted adhesive within said glue pot; and

(b) a feed controller responsive to said level sensor for automatically controlling operation of said adhesive loader to maintain the level of melted adhesive in said glue pot between said low and high levels.

12. An apparatus as recited in claim 11, further comprising an alarm system coupled to said feed controller which is activated whenever the level of melted adhesive within said glue pot is above said high level or below said low level.

13. An apparatus as recited in claim 1, further comprising:

(a) a color detecting sensor coupled to said glue pot to detect the color of said melted adhesive; and

(b) an alarm system coupled to said color detecting sensor which is activated whenever the color of said melted adhesive is darker than a predetermined threshold.

14. An apparatus as recited in claim 13, further comprising a programmed data processing system coupled to said color detecting sensor for activating said alarm system.

15. An apparatus as recited in claim 1, further comprising means for detecting viscosity of said melted adhesive.

16. A hot-melt adhesive application apparatus, comprising:

(a) a glue pot configured for holding melted hot-melt adhesive for use with an adhesive application device;

(b) a supply of hot-melt adhesive in a solid-form wrapped around a spool;

(c) an adhesive loader configured to unwind said solid-form hot-melt adhesive from said spool for input into said glue pot, said adhesive loader comprising,

(i) a pair of feed rollers positioned to cooperatively pull said supply of hot-melt adhesive between said feed rollers, said feed rollers having frictional surfaces for contacting said adhesive, and

(ii) a motor coupled to at least one of said feed rollers to draw said supply of adhesive from said spool; and

(d) a pre-heat device positioned between said adhesive loader and said glue pot for pre-heating said hot-melt adhesive unwound from said spool before said hot-melt adhesive material is input into said glue pot.

17. An apparatus as recited in claim 16, further comprising a pump fluidly connected to said glue pot and configured for pumping melted hot-melt adhesive from said glue pot to said adhesive application device.

18. An apparatus as recited in claim 16, wherein said melted-hot melt adhesive is gravity fed from said glue pot to said adhesive application device.

19. An apparatus as recited in claim 16, wherein said solid-form hot-melt adhesive comprises a continuous strand.

20. An apparatus as recited in claim 16, wherein said solid-form hot-melt adhesive comprises a continuous flat sheet.

21. An apparatus as recited in claim 16, wherein said solid-form hot-melt adhesive has a cross-sectional shape selected from the group of shapes consisting of circular, square, rectangular, hexagonal, and irregular.

22. An apparatus as recited in claim 16, wherein said pre-heat device maintains adhesive at a higher temperature than the temperature within said glue pot.

23. An apparatus as recited in claim 16, further comprising:

(a) a level sensor coupled to said glue pot for detecting a low level and a high level of melted adhesive within said glue pot; and

(b) a feed controller responsive to said level sensor for automatically controlling operation of said adhesive loader to maintain the level of melted adhesive in said glue pot between said low and high levels.

24. An apparatus as recited in claim 16, further comprising an alarm system coupled to said feed controller which is activated whenever the level of melted adhesive within said glue pot is above said high level or below said low level.

25. An apparatus as recited in claim 16, further comprising:

(a) a color detecting sensor coupled to said melting pot to detect the color of said melted adhesive; and

(b) an alarm system coupled to said color detecting sensor which is activated whenever the color of said melted adhesive is darker than a predetermined threshold.

26. An apparatus as recited in claim 25, further comprising a programmed data processing system coupled to said color detecting sensor for activating said alarm system.

27. An apparatus as recited in claim 16, further comprising means for detecting viscosity of said melted adhesive.

28. A hot-melt adhesive application apparatus, comprising:

(a) a glue pot configured for holding melted hot-melt adhesive for use with an adhesive application device;

(b) a supply of hot-melt adhesive in a solid-form wrapped around a spool;

(c) an adhesive loader configured to unwind said solid-form hot-melt adhesive from said spool for input into said glue pot, said adhesive loader comprising,

(i) a pair of feed rollers positioned to cooperatively pull said supply of hot-melt adhesive between said feed rollers, said feed rollers having frictional surfaces for contacting said adhesive, and

(ii) a motor coupled to at least one of said feed rollers to draw said supply of adhesive from said spool;

(d) a pre-heat device positioned between said adhesive loader and said glue pot for pre-heating said hot-melt adhesive unwound from said spool before said hot-melt adhesive material is input into said glue pot;

(e) a level sensor coupled to said glue pot for detecting a low level and a high level of melted adhesive within said glue pot; and

(f) a feed controller responsive to said level sensor for automatically controlling operation of said adhesive loader to maintain the level of melted adhesive in said glue pot between said low and high levels.

29. An apparatus as recited in claim 28, further comprising a pump fluidly connected to said glue pot and configured for pumping melted hot-melt adhesive from said glue pot to said adhesive application device.

30. An apparatus as recited in claim 28, wherein said melted-hot melt adhesive is gravity fed from said glue pot to said adhesive application device.

31. An apparatus as recited in claim 28, wherein said solid-form hot-melt adhesive comprises a continuous strand.

32. An apparatus as recited in claim 28, wherein said solid-form hot-melt adhesive comprises a continuous flat sheet.

33. An apparatus as recited in claim 28, wherein said solid-form hot-melt adhesive has a cross-sectional shape selected from the group of shapes consisting of circular, square, rectangular, hexagonal, and irregular.

34. An apparatus as recited in claim 28, wherein said pre-heat device maintains adhesive at a higher temperature than the temperature within said glue pot.

35. An apparatus as recited in claim 28, further comprising an alarm system coupled to said feed controller which is activated whenever the level of melted adhesive within said glue pot is above said high level or below said low level.

36. An apparatus as recited in claim 28, further comprising:

(a) a color detecting sensor coupled to said melting pot to detect the color of said melted adhesive; and

(b) an alarm system coupled to said color detecting sensor which is activated whenever the color of said melted adhesive is darker than a predetermined threshold.

37. An apparatus as recited in claim 36, further comprising a programmed data processing system coupled to said color detecting sensor for activating said alarm system.

38. An apparatus as recited in claim 28, further comprising means for detecting viscosity of said melted adhesive.

39. A hot-melt adhesive application apparatus, comprising:

(a) a supply of solid-form hot-melt adhesive;

(b) a heating unit configured for melting solid-form hot-melt adhesive for use with an adhesive application device; and

(c) an adhesive loader configured to continuously deliver said solid-form hot-melt adhesive to said heating unit.

40. An apparatus as recited in claim 39, further comprising a pump configured for pumping melted hot-melt adhesive to said adhesive application device.

41. An apparatus as recited in claim 39, wherein said melted-hot melt adhesive is gravity fed to said adhesive application device.

43. An apparatus as recited in claim 39, wherein said solid-form hot-melt adhesive comprises a continuous strand.

44. An apparatus as recited in claim 39, wherein said solid-form hot-melt adhesive comprises a continuous flat sheet.

45. An apparatus as recited in claim 39, further comprising a glue pot associated with said heating unit and configured for holding said melted hot-melt adhesive for use with said adhesive application device.

46. An apparatus as recited in claim 45, further comprising a pre-heat device positioned between said adhesive loader and said glue pot for pre-heating said hot-melt adhesive before said hot-melt adhesive is input into said glue pot.

47. An apparatus as recited in claim 46, wherein said pre-heat device maintains said adhesive at a higher temperature than the temperature within said glue pot.

48. An apparatus as recited in claim 39, wherein said supply of solid-form hot-melt adhesive is wrapped around a spool, and wherein said adhesive loader is configured to unwind said solid-form hot-melt adhesive from said spool.

49. An apparatus as recited in claim 48, wherein said adhesive loader comprises:

(a) a pair of feed rollers positioned to cooperatively pull said supply of hot-melt adhesive between said feed rollers; and

(b) a motor coupled to at least one of said feed rollers to draw said supply of hot-melt adhesive from said spool.

50. An apparatus as recited in claim 49, wherein said feed rollers include a frictional surface for contacting said supply of hot-melt adhesive.

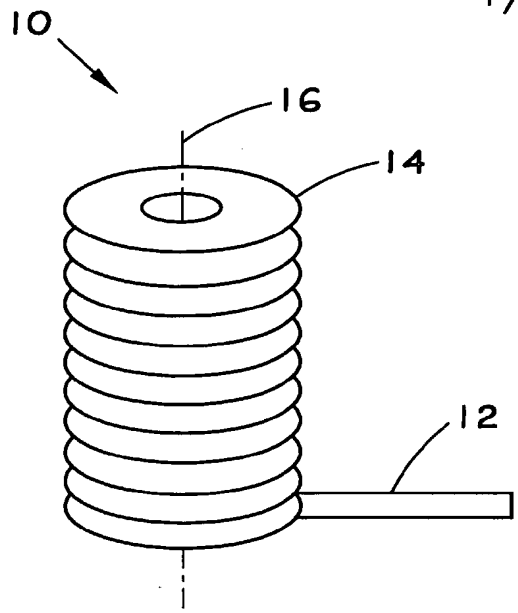

FIG. 1

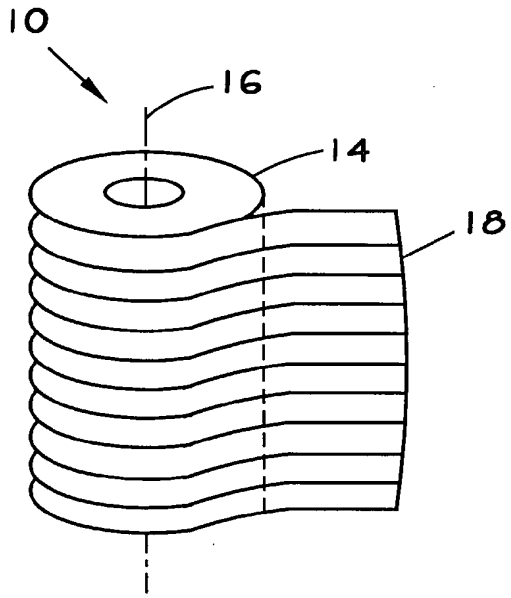

FIG. 2

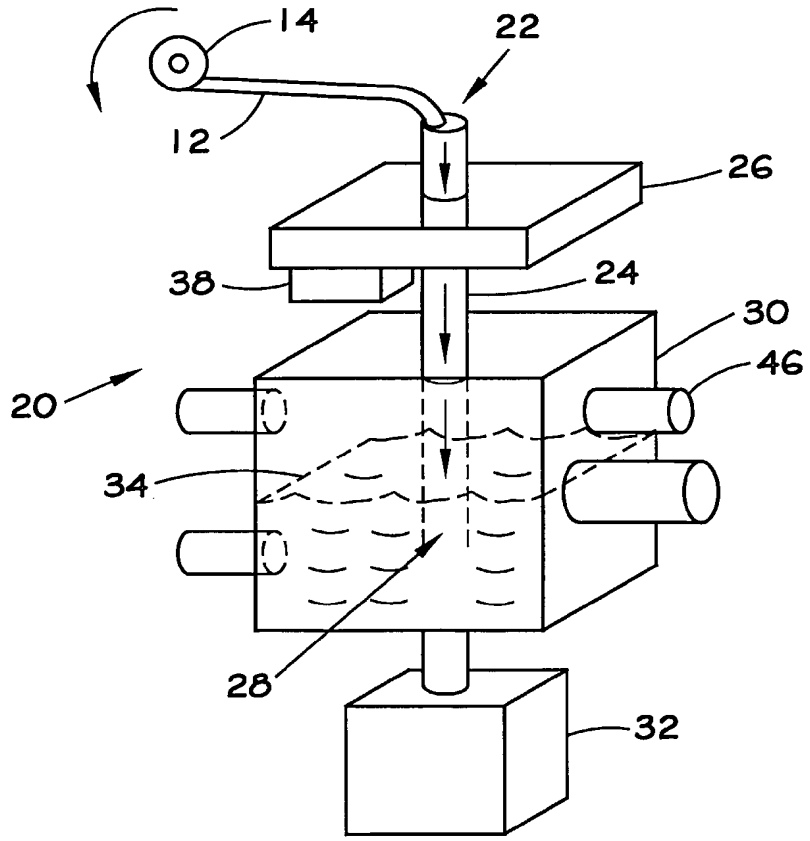

FIG. 3

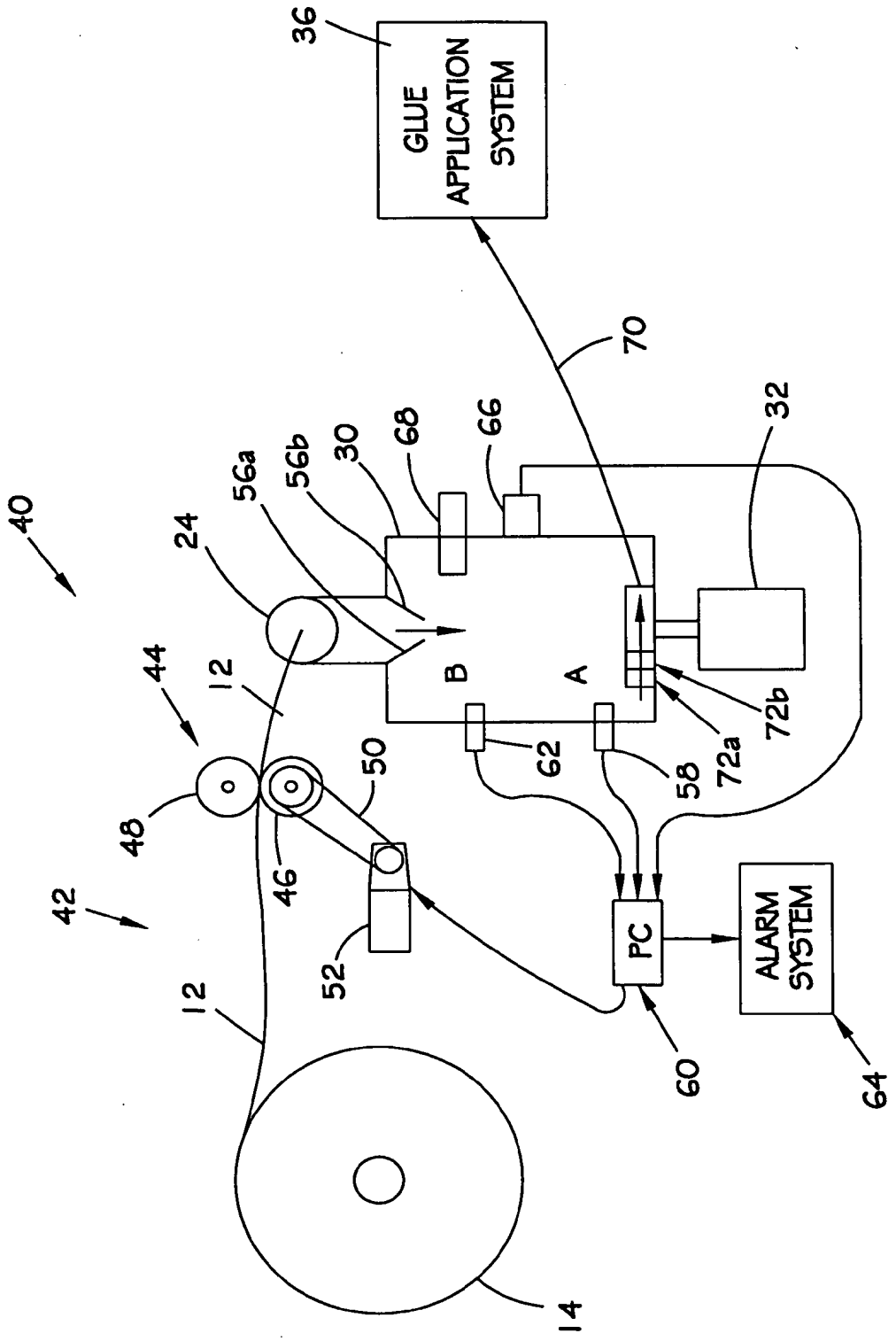
36
GLUE APPLICATION SYSTEM
70
32
66
68
30
56b
56a
24
40
44
12
B
A
72b
72a
62
58
50
48
46
42
52
12
PC
ALARM SYSTEM
60
64
14

FIG. 4

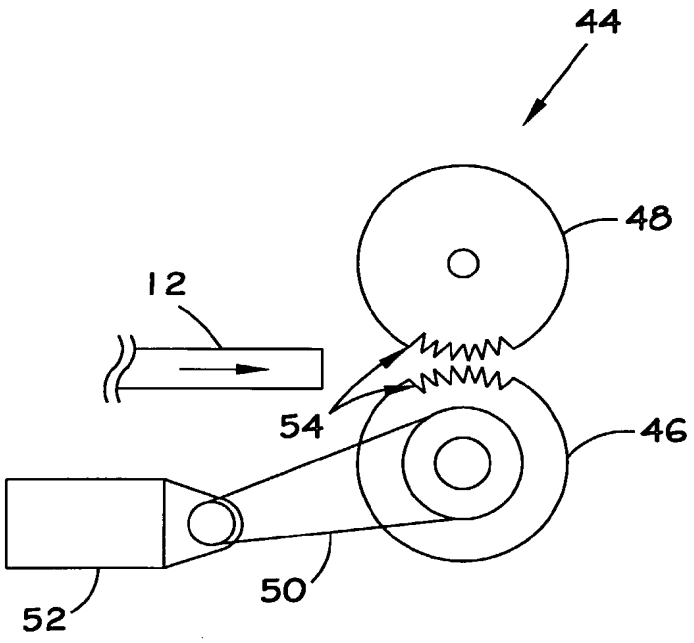

FIG. 5

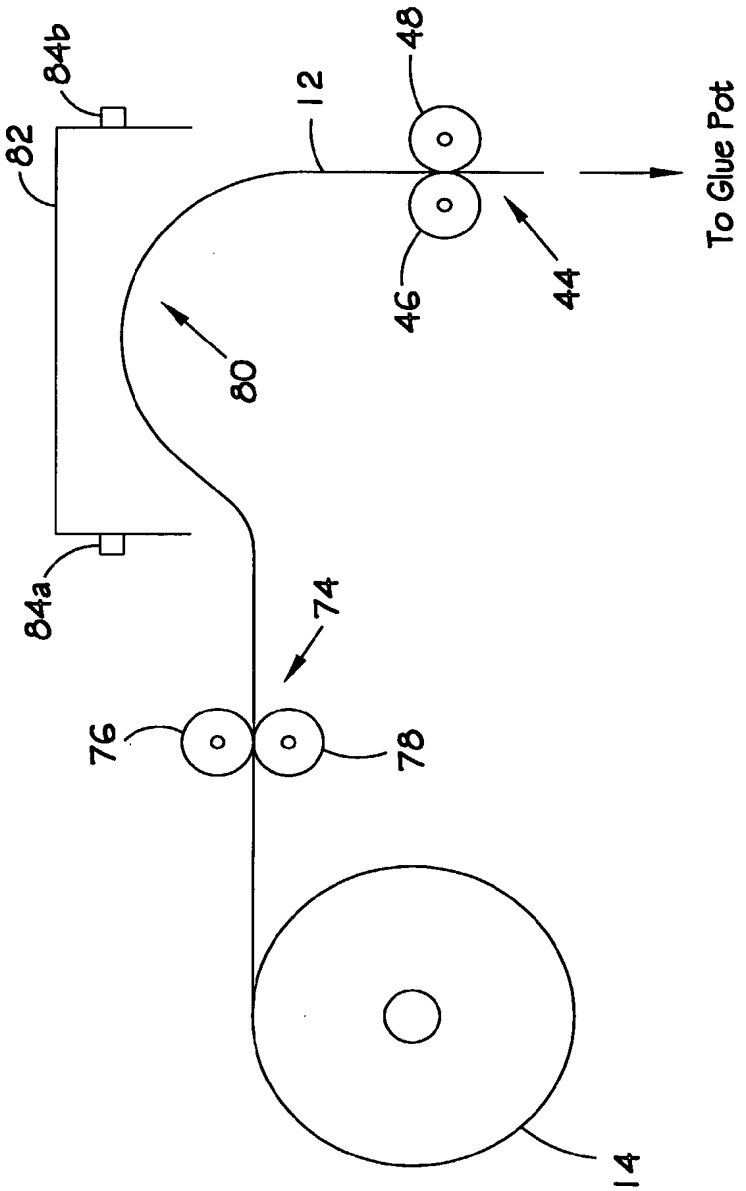

FIG. 6

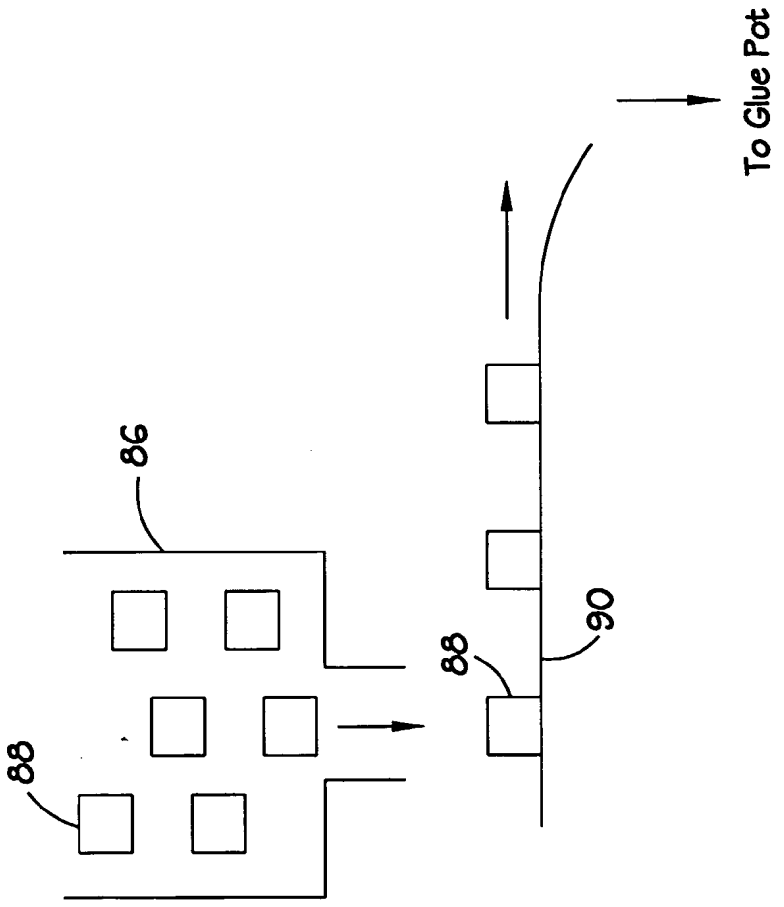

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/11887

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :B67D 5/62
US CL :156/578; 222/56, 63, 64, 146.1, 146.2, 146.5
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 156/578; 222/56, 63, 64, 146.1, 146.2, 146.5

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 4,804,110 A (SPERRY ET AL) 14 February 1989 (14.02.89), entire document.	1, 2, 5, 7-9, 11,39,40, 43,45, 48-50 --- 3-4, 6, 10, 12-38, 41, 42, 44,46,47
Y	US 4,613,062 A (WALTER ET AL) 23 September 1986 (23.09.86), entire document.	1-50
Y	US 3,377,012 A (CUSHMAN) 09 April 1968 (09.04.68), entire document.	1-50
Y	US 3,318,481 A (PHILLIPS ET AL) 09 May 1967 (09.05.67), entire document.	1-50

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 08 JULY 2001	Date of mailing of the international search report 02 AUG 2001
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer JEFF AFTERGUT Telephone No. (703) 308-0661

Form PCT/ISA/210 (second sheet) (July 1998) ★